II. INTRODUCTION

4. The Office Action dated April 20, 2005 has been carefully considered. Reconsideration of this application, in view of the following remarks, is respectfully requested.

A. References

5. The following U.S. patents were relied on in the office action:

- US Patent 6,058,215 ("Schwartz"), filed April 30, 1997.
- US Patent 6,005,979 ("Chang."), filed January 13, 1997.
- US Patent 4,743,959 ("Frederiksen"), filed September 17, 1986.
- US Patent 5,271,072 ("Yoshida."), filed July 24, 1992

B. Overview of Office Action

6. The office action:

a) Provided new grounds of rejection using Yoshida as a new reference.

b) Rejected claims 11-12, 14-15 as being obvious in light of Schwartz et al. in combination with Chang et al. and Yoshida et al. under 35 U.S.C. 103(a).

c) Rejected claim 13 as being obvious in light of Schwartz et al., Chang et al. and Yoshida et al. in further combination with Frederiksen under 35 U.S.C. 103(a).

C. Claim Rejections under 35 U.S.C. 103(a)

7. The office action rejected claims 11-12 and 14-15 as being obvious in light of Schwartz in combination with Chang and Yoshida under 35 U.S.C. 103(a). Claim 13 is rejected in light of Schwartz et al., Chang et al., Yoshida et al., (as applied to claim 11) and in further view of Frederiksen under 35 U.S.C. 103(a).

III. IN THE CLAIMS

D. Claim 12

8. Please amend claim 12 to add the words, "sub-sampled from each pixel wherein the number of pixel bits sub-sampled is less than the number of bits of the pixel being sub-sampled". This change is being made to clarify that the number of pixel bits sub-sampled is less than the number of bits in pixel being sub-sampled. For example, if the original pixel is 24 bits, the sub-sample may only be 5 bits (as shown in Fig 2G in combination with ZL5-3 format, Fig 8A at 805) or 9 bits (as shown in ZL9-7C format, Fig 8B at 820). The original wording of "sub-sampled" implies that the sub-sample is smaller than the original, but this wording clarifies the claim language and more precisely describes what is being claimed. This wording change is not being made to overcome prior art.

9. This change was not made to overcome prior, such as Chang, because as discussed below, Chang did not teach subsampling which was already present in the language of claim 12 which referred back to claim 11.

IV. DISCUSSION OF NEW GROUNDS--YOSHIDA

E. Yoshida Basis of New Grounds

10. The office action added Yoshida to previously argued combinations to suggest the obviousness of claims 11-15, all of the pending claims. Specifically, the office action relies on Yoshida, stating "Yoshida et al teaches an image reduction apparatus (encoder) comprising subsampling each pixel data (Fig. 1, 6: col 5, lines 24-26)"

F. Yoshida Misunderstood

11. The office action misunderstands Yoshida; it does not teach what the examiner relies upon it as supposedly teaching. The office action equates Yosida's

"subsampling section" 6 with Applicant's "a pixel value comprising a number of pixel bits sub-sampled from each pixel when scanning said plurality of pixels". However, as shown in Yoshida Fig 5 and explained in col. 5 lines 15-22, "FIG. 5 shows positions where the subsampling is made by the subsampling section 6. A subsampled image which is 1/2 size in the vertical and horizontal directions (1/4 in the term of area ratio) can be formed by sampling data shaded in the FIG. 5 at every other timing in the main scanning (horizontal) direction and the subscanning (vertical) direction." Yoshida teaches *image subsampling* where every other horizontal pixel in every other vertical row of pixels is selected from an image, resulting in ½ the width and height and ¼ the number of pixels. Yoshida's *image subsampling* is not the same as Applicant's *bit* subsampling where a pixel value is determined by selecting a number of bits from each pixel, resulting in the same number of values as there originally were pixels (not ¼ as is the result of Yoshida's subsampling).

12. The following table outlines the different types of subsampling that have been distinguished so far during prosecution of this application.

Frame Subsampling	Selection a subset of frames (or images) in a series of video frames
Image Subsampling	Selection of a subset of pixels from an array of pixels that make up a single frame, by skipping pixels in a row or by skipping rows. **(Yoshida, Chang)**
Area Subsampling	Selection of a subset of pixels from the array of pixels that make up a single frame, by selecting sub-area that has either a width or height less than the original image, but without any skipping pixels in that sub-area
Bit Subsampling	Selection of a subset number of bits from each pixel **(Applicant's claim 11).**

13. The subsampling taught by the prior art, such as Yoshida and Change, is image subsampling which is distinct from bit subsampling. Applicant's invention may be distinguished over the proposed combination of Schwartz, Chang, and Yoshida, by the existing language of claim 11, namely, "a pixel value comprising a number of pixel bits sub-sampled from each pixel when scanning said plurality of pixels".

G. Yoshida Adds No New Teaching to the Combination of Schwartz and Chang

14. As discussed below, the subsampling taught by Chang, like Yoshida, is *image* subsampling, not Applicant's *bit* subsampling. Yoshida's Fig. 5 sheds light on what Chang and Yoshida are really teaching, namely image subsampling, but does not present a new teaching that would make Applicant's invention obvious.

H. Support Still Lacking for Bit Subsampling from Each Pixel

15. The office actions acknowledges that:

- "Schwart et al does not specifically disclose counting repeated instances of a pixel value comprising a number pixel bits sub-sampled from each pixel when scanning a plurality of pixels." (page 3, paragraph 2, emphasis in office action)
- "Chang et al subsamples image data as opposed to subsampling each pixel bits" (page 3, paragraph 4)

As discussed above:

- Yoshida subsamples image data as opposed to subsampling each pixel bits.

16. Thus, there has not been a clear showing of prior art that would render obvious claim 11's limitation of "a pixel value comprising a number of pixel bits sub-sampled from each pixel when scanning said plurality of pixels".

V. DISCUSSION OF RUN-LENGTH ENCODING

I. Conventional Run Length Encoding

17. The office action notes that "conventionally run-length encoding (RLE) consists of strings of bits as a number indicating the length of a series of zeros, followed by a non-zero element, and repeats 'til end." (emphasis in office action). This is one type of run-length encoding, where only runs of zeros are encoded with a run length and non-zero values stored as is. Note that Schwartz teaches this type of run-length encoding, namely, numeral 124, which is labeled "Runlengths of zeros".

18. Applicant further acknowledges that other types of run length encoding were known in the art. The Oxford Dictionary of Computing (1996) defines run-length encoding as "A lossless compression technique where a sequence of pixels with the same value is replaced by a value and a count." The specification also distinguishes the present invention over the RHN format and method of run length encoding, discussed in reference to Fig 5B, 5C, and 7.

J. Fig 6 Not Limited to Run-Length Encoding of Zero Values

19. Although Fig 6 shows an example of zero values being repeated, the method of the present invention is not limited repeating zero values. Note that each code has as data field and a count field, "each containing a merged value and count, (651, 652), (654, 655), and (657, 658), respectively". In Applicant's invention when a value of "2" is repeated more than once, the sequence is encoded with a value and a count. If the data (620, 622, 624, 626 and 628) had been 2, 2, 2, 2, and 2, respectively, the first byte 650 of encoded data would have the binary value of 00010 in 651 and 101 in 652.

20. Applicant's run-length encoding element can be distinguished from conventional run length of zeros encoding in that each sequence of data values will be encoded regardless of whether the data value is zero or non-zero.

K. Distinguished over RHN's Patentable Run Length Encoding

21. As discussed in reference to Fig 7, the details of applicant's run length encoding can be distinguished by its specific format and improved results over other compression methods (or systems).

22. On August 10, 2005, the US PTO issued a notice of allowance on the RHN application, 09/470,566, which allowed a machine claim that included the run length encoding as shown in Fig 7. As discussed in the specification, the present invention as shown in Fig 6 has superior results over RHN.

L. Crowded Art—Small Step Forward

23. As evidenced by the many references cited in this case, the area of image compression is one of crowded art. There are many types of compression, each using different combinations of various techniques, with many patentable distinctions. Differences in run length

encoding formats have even been found to be patentable. Applicant submits, that like RHN's improved run-length encoding, the present invention's small step forward, with improvement in data reduction over RHN, should be found patentable.

VI. DETAILED ANALYSIS OF PRIOR ART

24. In the following detailed analysis, the distinctions between the elements of the prior art and of the Applicant's invention will be discussed. When individual elements are combined, the combination suggested by the Office Action fails to suggest the subject mater of the pending claims. The subject matter of Applicant's invention as a whole would not have been obvious.

M. Schwartz Does Not Teach Elements Referred to by the Office Action

25. The office action fails to present a clear argument why the claimed subject matter as a whole would have been obvious. Regarding claims 11, 14, and 15, the office action cites Schwartz teaching:

- A video digitizer at col 5, lines 5-8, for digitizing a frame from the video frames
- A video memory for receiving a plurality of pixels (col. 5, lines 3-5)
- An encoding circuit (Fig 1B) for sub-sampling from each pixel (121) when scanning the plurality of pixels and outputting a series of encoded data comprising a combined run-length (run) field and a data (length) field, know as run-length encoding (124) and
- a memory for storing encoded data and an input/output devices, which are storage medium and a communications transmission channel (Fig. 1B, Channel/storage).

26. The same references are also used in combination to reject claims 12 and 13.

N. Schwartz Fails Teach What is Relied on by the Office Action

27. The citations do not teach what the office action relies on for the combination to teach.

O. Schwartz Fig 1B Does Not Teach Applicant's Encoding Circuit

28. Schwartz Fig 1B shows an encoding circuit composed of seven steps. The reference does not teach what the Office Action relies upon it as supposedly teaching. Schwartz does not clearly teach "a pixel value comprising a number of pixel bits sub-sampled from each pixel", rather Schwartz merely teaches "color space or subsampling block 121 which performs color space conversion or subsampling of the input data." (Schwartz 5:37-40) This does not clearly teach the required limitation of "a pixel value comprising a number of pixel bits sub-sampled from each pixel". One of ordinary skill in the art would have understood this to refer to color space conversion from RGB to YCbCr where the resolution of the two chrominance components Cb and Cr is reduced, such as taught by Frederiksen where "a pair of chrominance components (R-Y) [Cr] and (B-Y)[Cb] for every four horizontal pixels in the image" is "then averaged so that a block is finally represented by two pairs of chrominance components" (Federiksen 5:64-6:13). This is not the same as subsampling a number of pixel bits for <u>each</u> pixel.

29. Further, Schwartz does not teach "outputting a series of encoded data comprising a combined run-length field and a data field". The Office Action cites reference numeral 124, which is labeled "Runlengths of zeros" and is described as "run length block 124 which identifies run lengths of zeros. The output of run length block 124 is coupled to the input of Huffman coder 125, which performs Huffman coding." (Schwartz 5:48-52). This is not the same as Applicant's encoded data that has a run-length field and a data field. In Schwartz

because the run-lengths are of zeros there is no need to have a data field. In this regard, Schwartz teaches away from the present invention. Further, Schwartz teaches a Huffman coding step that occurs prior to outputting the encoded data. Further, applicant's invention omits many elements of Schwartz's compressor (namely, block averaging, the Discrete Cosine Transform (DCT), quantization, zig-zag, Huffman coding, and signaling), thus Applicant's invention is made simpler.

P. The Combination of Schwartz, Chang and Yoshida Does Not Teach Applicant's Encoding Circuit

30. The Office Action admits that Schwartz does not specifically disclose counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled, and relies on Chang and Yoshida to teach the missing element. However, as discussed above, neither Chang nor Yoshida teach the missing element.

31. Chang Figs 1, 3a, and 3b do not teach "counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled from each pixel" as required by claim 11. As shown in Fig 1, 13 and 14', Chang teaches *image subsampling*, not pixel *bit* subsampling. The block labeled "subsample by n" (Fig 1, 13) is described as "subsampling block 13, in which the amount of data along each direction in the data array is reduced systematically by a factor n to produce a subsample 14" (Chang 8:39-42). On Fig 1, this is labeled "sub-sampled image" 14'. This image subsampling is shown in Fig 3a and 3b: "FIG. 3a is a hypothetical very small original image data array, FIG. 3b is a subsample of the FIG. 3a data, for a subsampling ratio of two" (Chang 8:16-18) and "For n=2 the system retains data in only every other pixel, in both directions of the array--so the subsample 14 (FIG. 3b) has just 2 rows x 3 columns=6 pixels, one quarter of the number (24) in the original image array 11. The pixels in

the subsample--and the data for those pixels--are identically pixels aa, ac, ae, ca, cc, and ce." (Chang 15:34-39, emphasis added). Unlike the present invention where "a number of pixel bits sub-sampled from each pixel", Chang teaches that all of the bits from only every other pixel are retained. In this regard, Chang teaches away from the present invention.

32. Further, Chang does not teach "counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled from each pixel" as required by claim 11. Chang in Fig 1, 27 teaches a "classical run-length encoding (RLE) module 27". However, Chang does not teach "counting repeated instances of a pixel value". Instead, Chang teaches "correction information 26 only for pixels where correction is most needed" (Chang 10:36-38, emphasis added). This correction information 26 (also known as trim data) is not the same as applicant's "pixel value comprising a number of pixel bits sub-sampled from each pixel". Further, the array of correction information "consisting (unlike the original image array) primarily of zeroes, is then ideally suited for the previously mentioned classical run-length encoding (RLE)" (Chang 11:31-35, emphasis added). Like Schwartz, Chang's run-length encoding appears to be counting runs of zeros. Thus, neither Schwartz, Chang, nor the proposed combination suggest "counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled from each pixel" or "encoded data comprising a combined run-length field and a data field" as required by claim 11.

33. Further, applicant's invention omits many elements of Chang's compressor (namely, image subsampling13, bileanear interpolation 15/31, residual calculation 23, and adaptive thresholding 25), thus Applicant's invention is made simpler.

34. Further, as discussed above, as shown in Yoshida Fig 5 and explained in col. 5 lines 15-22, "FIG. 5 shows positions where the subsampling is made by the subsampling

section 6. A subsampled image which is 1/2 size in the vertical and horizontal directions (1/4 in the term of area ratio) can be formed by sampling data shaded in the FIG. 5 at every other timing in the main scanning (horizontal) direction and the subscanning (vertical) direction." Like Chang, Yoshida teaches *image subsampling* where every other horizontal pixel in every other vertical row of pixels is selected from an image, resulting in ½ the width and height and ¼ the number of pixels. Yoshida's *image subsampling* is not the same as Applicant's *bit* subsampling where a pixel value is determined by selecting a number of bits from each pixel, resulting in the same number of values as there originally were pixels (not ¼ as is the result of Yoshida's subsampling).

35. Yoshida shows 2 frame memories in Fig 1 (1, 7) with a feedback (71) combing back to the other components 2 and 3. Further in Fig 8, Yoshida shows two instances of the reduction circuit (16, 18) that must operate prior to encoding (21, 23, and 25). This design would not allow subsampling to occur "when scanning" as required by claim 11. Thus, Yoshida teaches away from counting repeated instances of a bit-wise sub-sampled value when scanning.

36. Further, applicant's invention omits many elements of Yoshida's machine (namely, filter operating section 2, exception processing section 3, comparator 4, selector 5, reference pixel determination circuit 22 & 24, and encoder 21, 23, & 24), thus Applicant's invention is made simpler.

Q. The Combination of Schwartz, Chang, and Yoshida is Improper

37. Schwartz, Chang and Yoshida do not individually contain any suggestion that they be combined, especially in the manner suggested. Further, the references are individually complete so there would be no reason to use parts from or to add or substitute parts to any reference. The references take different overall approaches to solving the compression

problem; since they teach away from each other, it would not be logical to combine them. Further, as discussed above, the references teach away from the suggested combination (see discussion above regarding "image subsampling", "every other pixel", "runs of zeros", and "data field")

38. Finally, even if the Schwartz, Chang and Yoshida were combined as suggested, the combination would not meet the limitations of the claims, such as "counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled from each pixel" or "encoded data comprising a combined run-length field and a data field" as required by claim 11(c), as discussed above. Thus, the combination still lacks the claimed feature.

R. Applicant's Invention

39. Applicant's invention is a simple, fast, effective, on-the-fly, one-pass, clinically lossless way of compressing a video signal. As pixels are digitized and received into a video memory, the present invention is able to extract a pixel value by subsampling a predetermined number of bits from each pixel, and then count repeated instances of that bit-wise sub-sampled value. The encoding circuit is able to do this in one pass, on-the-fly, "when scanning" and outputs a data code for each run of extracted pixel values. While not a limitation of claim 11 as currently amended, an embodiment of this invention could hypothetically output encoded data as soon as two or more pixels were digitized. This is much different than the methods and apparatus taught by the cited references, performs many different steps and takes different approaches. The present invention eliminates many steps found in the cited art and is able to provide clinically lossless results that cannot be achieved by the prior art.

S. Claims 11, 14, and 15 Not Rendered Obvious by Schwartz, Chang and Yoshida

40. As discussed above, neither Schwartz, Chang, Yoshida, nor their combination teach the elements of the present invention. Neither Schwartz, Chang, Yoshida or the suggested combination teach "an encoding circuit for counting repeated instances of a pixel value comprising a number of pixel bits sub-sampled from each pixel when scanning said plurality of pixels and outputting a series of encoded data comprising a combined run-length field and a data field" as required by claim 11(c). Further *the office action did not point out* where either Schwartz, Chang, or Yoshida teaches a video memory as required by claim 11(b).

41. Further, Schwartz, Chang and Yoshida teach away from counting repeated instances of a bit-wise sub-sampled value <u>when scanning</u>. The present invention omits many elements of the cited prior art, makes compression faster and simpler and results in superior image quality. The present invention goes against the grain of prevailing discrete cosign transform (DCT) compression techniques taught by the prior art. Products incorporating the present invention have been licensed and used by hospitals in the University of California system. The present invention provides many unexpected results or unappreciated advantages over the prior art as outlined in the "Objects and Advantages" section of the specification. Thus, neither Schwartz, Chang, Yoshida, nor their combination, render the claims obvious.

T. Claims 12 Not Rendered Obvious by Chang

42. Claim 12 is a dependent claim, and, for all the reasons stated above with respect to independent claim 11, should be patentable over Chang in combination with the other references.

43. Claim 12 has been amended to clarify that the number of bits sub-sampled is less than the number of bits in the original. This change was not made to overcome Chang because as discussed herein Chang did not teach subsampling which was already present in the language of claim 12 which referred back to claim 11.

44. As cited by the Office Action, Chang discloses RGB pixels where each color red, green, and blue is represented by eight bits in a 24-bit pixel (see Chang 1:33-43). However, teaching a 24-bit pixel does not teach "a pixel value comprising a number of pixel bits sub-sampled from each pixel". As discussed above, Chang's disclosure is not the same as Applicant's *subsampling* "a number of pixel bits" because all 24 bits are preserved for the selected pixels, and all eight bits for each component are preserved (see Chang Fig 3a and 3b). For example, "[a]s shown, each pixel has three associated eight-bit data values; these may be considered as corresponding to the three primary lights red, green and blue respectively. ... In pixel aa for example the red level is 253, the green 18 and the blue 92" (Chang 15:13-19). In Applicant's invention, if the pixel had 24 bits, a *bit-wise sub-sampled* pixel value would be *less than* 24 bits, and if the pixel had 8 bits, a bit-wise sub-sampled pixel would have *less than* 8 bits. For example, Applicant's Fig 3A shows a 5-bit pixel value being sub-sampled from an 8-bit pixel and Fig 1380a shows a "24 to 5 bit sub-sampler". Chang does not disclose 8 as "the number of pixel bits [sub-sampled from each pixel]" but rather 8 as the number of bits for each of the three components. All 24 bits are still preserved, because there is no bit-wise *subsampling*. The cited reference does not teach bit-wise *subsampling to reduce the number of bits* in a pixel value as required by claim 11 and its dependent claim 12.

45. Further, Chang teaches away from bit-wise subsampling to obtain a smaller number of bits. Thus, Chang does not render claim 12 obvious.

U. Claims 13 Not Made Obvious by Schwartz, Chang, Yoshida and Frederiksen

46. Claim 13 is a dependent claim, and, for all the reasons stated above with respect to independent claim 11, should be patentable over the suggested combination of Schwartz, Chang and Yoshida.

47. Frederiksen does not teach "a pixel value comprising a number of pixel bits sub-sampled from each pixel" (claim 11(c)) "wherein said pixel value is extracted from the most significant bits of each color component" (claim 13). Instead, Frederiksen teaches a median luminance value (derived from a plurality of pixels) and average chrominance values (also derived from a plurality of pixels) (see, Frederiksen 7:58-62). Even if Frederiksen were combined with Schwartz, Chang and Yoshida, the combined teachings would still not meet the limitations as set forth in claim 13 (and claim 11 upon which it depends). It would still require a modification not suggested by any of the references.

48. As stated above, Schwartz, Chang and Yoshida do not teach bit-wise subsampling to extract a subset of bits as the pixel value. Because Schwartz, Chang and Yoshida do not teach extraction of a smaller number of bits, it would not be obvious to combine Frederiksen's extraction of the most significant bits of each color component with Schwartz, Chang and Yoshida. There is no teaching or motivation to combine. All three references are complete in themselves and take mutually exclusive paths. Further, Frederiksen was published in 1988 and was available to each of Schwartz, Chang and Yoshida, yet none chose to adopt Frederiksen's approach. Even if the references were combined, the combination would not result in Applicant's invention. The resulting combination would still take a much different, conventional approach to video compression, would include many elements omitted by the present invention, and would not have the resulting clinically lossless quality of the present

invention. Thus, Schwartz, Chang and Yoshida in view of Frederiksen do not render claim 13 obvious.

VII. AMONG CROWDED ART, APPLICANT'S INVENTION PROVIDES A NEW PRINCIPLE OF OPERATION

49. As can be seen by the many references cited and overcome to date in this application, there is crowded art where even small steps in the area of block transform based compression techniques, or run-length encoding, have been regarded as patentable. Applicant's invention blazes a new trail, rather than following the crowd and their standard block based, transform based approaches. Applicant's invention instead is a simple, fast, effective, on-the-fly, one-pass, clinically lossless way of compressing a video signal. As pixels are digitized and received into a video memory, the present invention is able to extract a pixel value by subsampling a predetermined number of bits from each pixel, and then count repeated instances of that bit-wise sub-sampled value. The encoding circuit is able to do this in one pass, on-the-fly, "when scanning" and outputs an data code for each run of extracted pixel values. The present invention eliminates many steps found in the cited art and is able to provide clinically lossless results that cannot be achieved by the prior art.

VIII. RECONSIDERATION REQUESTED

50. The undersigned respectfully submits that, in view of the foregoing remarks, the rejections of the claims raised in the Office Action have been fully addressed and overcome, and the present application is believed to be in condition for allowance. It is respectfully requested that this application be reconsidered, that these claims be allowed, and that this case be passed to issue. If it is believed that a telephone conversation would expedite the

prosecution of the present application, or clarify matters with regard to its allowance, the Examiner is invited to call the undersigned inventor at 408-739-9517.

Respectfully submitted,

Date: September 16, 2005

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